

First records of the minor pest termite *Eucryptotermes hagenii* (Müller, 1873) (Blattodea, Termitoidae, Kalotermitidae) from the Chaco Dominion in Argentina

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Abstract

Eucryptotermes Holmgren, 1911, comprises 2 species of Neotropical drywood termites with phragmotic head soldiers. We report the presence of *Eucryptotermes hagenii* (Müller, 1873) in native forests of the Chaco Dominion and Chaco Province, enlarging its distribution and recording the genus and species for the first time in Argentina. *Eucryptotermes hagenii* abundance was estimated as intermediate by standardized sampling. Eighteen morphometric characters were measured in soldiers and alates, and 9 of them provided new data. The colonies, located inside living trees trunks and dead wood, were composed of reproductives, soldiers, pseudergates, and immatures.

Key words

Insecta; drywood termites; South America; distribution.

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Introduction

Eucryptotermes Holmgren, 1911, is a little-known and highly specialized endemic Neotropical genus of “dry-wood termites” that live in trees and pieces of wood. Soldiers have truncated heads with a remarkable degree of phragmosis (Krishna 1961). This genus has only 2 described species, the type species, *E. hagenii* (Müller, 1873), and *E. breviceps* Constantino, 1997. These two species were previously known only in Brazil, in the Brazilian and Chaco Subregions, respectively (Araujo 1977, Constantino 1998, Krishna et al. 2013).

The published data on *E. hagenii* are few and include some biological and cytogenetic aspects, as well as its

pest status. Most of records of *E. hagenii* are from natural habitats in southeastern Brazil, but it is also known from urban areas, such as Curitiba and Blumenau, which indicates that it could be an occasional structural pest (Constantino 1997, 1998). In the city of São Paulo, where the most significant termite damage is caused by *Cryptotermes* Banks, 1906 and *Coptotermes* Wasmann, 1896, *E. hagenii* is considered to be a minor urban pest (Fontes 1995, Constantino 2002). From a cytogenetic and evolutionary point of view, this species is unusual because it has the lowest number of chromosomes so far reported for termites, with $2n = 22$ (Martins and Mesa 1995).



Figure 1. Geographical distribution of the genus *Eucryptotermes* (South America). Circle: *E. breviceps*; squares: *E. hagenii*.

We report for the first time the presence of *E. hagenii* in natural habitats in the Chaco Dominion in Argentina. Our new records enlarge the known range of this species and also provide new information on its biology and morphometry.

Methods

The samples were collected as part of a research project on termite communities in the Humedales Chaco Ramsar Site at the Los Chaguares Reserve (Colonia Benítez, Chaco province, Argentina) between September 2016 and February 2017 (Fig. 1) (27°20.00'S, 058°58.03'W). The Reserve (19 ha) is located in an area with humid mesothermal climate and little winter rainfall, where the average annual temperature is above 18 °C. Biogeographically, it belongs to the Chaco Subregion, Chaco Dominion, Chaco Province, Eastern Chaco District or Humid Chaco Ecoregion and is characterized by the presence of grasslands, floating islands (“embalsados”),

gallery forests, and xerophytic forests (Morrone 2014). The vegetation in the study area is a riverbank forest with trees up to 15 m high (Cabrera and Willink 1973, Cabrera 1976).

The standardized sampling protocol for termites (Jones and Eggleton 2000) was applied, consisting of 2 transects, each 100 × 2 m, that are divided into 20 contiguous sections (5 × 2 m). Termites were collected in each section (1 person/h) in various microhabitats, including fallen tree trunks and branches, mounds, and arboreal nests. Twelve samples of surface soil (12 × 12 cm, 10 cm deep) were excavated in each section. The total number of termite encounters per transect was counted.

The abundance of *E. hagenii* was estimated in the surveyed areas, defining their occurrence, dominance and abundance patterns according to the categories established by Florencio and Diehl (2006). To determine the occurrence pattern, the species are categorized as rare (R: present in 1–10% of sections), sporadic (S: 11–40% of sections), common (C: 41–70% of sections), frequent

(F: 71–99% of sections), and constant (CS: 100% of sections). The following formula was applied: $OP = \text{numbers of sections where the species was found} \times 100 / \text{total number of evaluated sections}$. For the dominance pattern, the species are classified as rare (R: 1–10% of encounters), accessory (A: 11–49% of encounters), and dominant (D: 50–100% of encounters), according to the formula $DP = \text{number of encounters of each species} \times 100 / \text{total number of encounters}$. The combination of both patterns is used as an indicator of the abundance of each species, according to the following categories: common (C: species with CS and D patterns), intermediate (I: species with R, S, C or F and A and species with S, C, F or CS and R), and rare (R: species with R in occurrence and dominance patterns).

Specimens were identified by M.C. Godoy (first author) using taxonomic keys and descriptions (Müller 1873, Silvestri 1903, Holmgren 1911, Krishna 1961, Constantino 1997, 1999) and by comparisons with samples of *E. hagenii* from São Paulo, Brazil, which were determined by L.R. Fontes (Termite collection, Facultad de Ciencias Exactas y Naturales y Agrimensura, Universidad Nacional del Nordeste, Corrientes, Argentina; FACENAC).

Voucher specimens were preserved in 80% ethanol and deposited in the FACENAC (registration numbers 2512–2518). The specimens were collected under the authorization of the Dirección de Fauna, Parques y Ecología, Chaco Province.

In soldiers and alates, 18 morphometric characters (Roonwal 1970, Scheffrahn and Křeček 1999) were measured with a micrometric eyepiece attached to a Leica EZ4 stereomicroscope. Microphotographs were taken with a Canon EOS Rebel T3 digital camera coupled to the microscope. For scanning electron microscopy, the specimens were dehydrated in a conventional ethanol series, air-dried, gold-coated, and photographed with the SEM Jeol 5800 LV from the UNNE Microscopy Service. The map was elaborated by using QGIS Essen version 2.14 (QGIS 2016).

Results

New records. Argentina, Chaco, Colonia Benítez (27° 20.00'S, 058°58.03'W): MCG and ERL, 24 November 2016, FACENAC 2512, 7 alates, several soldiers and pseudergates; GMA, 23 November 2016, FACENAC 2513, 1 soldier and several pseudergates; MCG and ERL, 24 November 2016, FACENAC 2514, 1 soldier and several pseudergates; JMC and ERL, 24 November 2016, FACENAC 2516, several pseudergates; JMC and CE, 24 November 2016, FACENAC 2517, 1 dealate, 4 soldiers and several pseudergates; MCG, 24 November 2016, FACENAC 2518, 2 dealates, 3 soldiers and several pseudergates; JMC and GMA, 23 November 2016, FACENAC 3155, several prealates and pseudergates; MCG and ERL, 23 November 2016, FACENAC 3157, 1 soldier and several prealates.

Identification. Soldiers of *E. hagenii* (Figs 2–6) have a dark brown, short, and broad sub-truncated or phragmotic head, with almost straight parallel sides and a slight constriction at the antennae level. The frontal region of the cephalic capsule is extended forward, forming a sharp circular ridge or frontal flange located dorsally between the vertex and the frons and between the frons and the genae on both sides. The antennae are inserted at about one-third or one-half of the length of the head from the front sides (Fig. 4). The mandibles are partially covered by the cephalic capsule in dorsal view, and its inner edge is slightly serrated without notable teeth. The pronotum is brownish yellow with its anterior margin rising abruptly in profile, emarginated, and strikingly serrated (Fig. 5). The alates of *E. hagenii* have a uniformly brownish yellow coloration and transparent wings (Fig. 7). The pronotum is narrower than the head. The anterior margin of the forewing scale is almost straight or very slightly convex and forewings have all major veins emerging independently at the wing suture. The 18 morphometric characters measured on *E. hagenii* soldiers and alates are presented in Table 1.

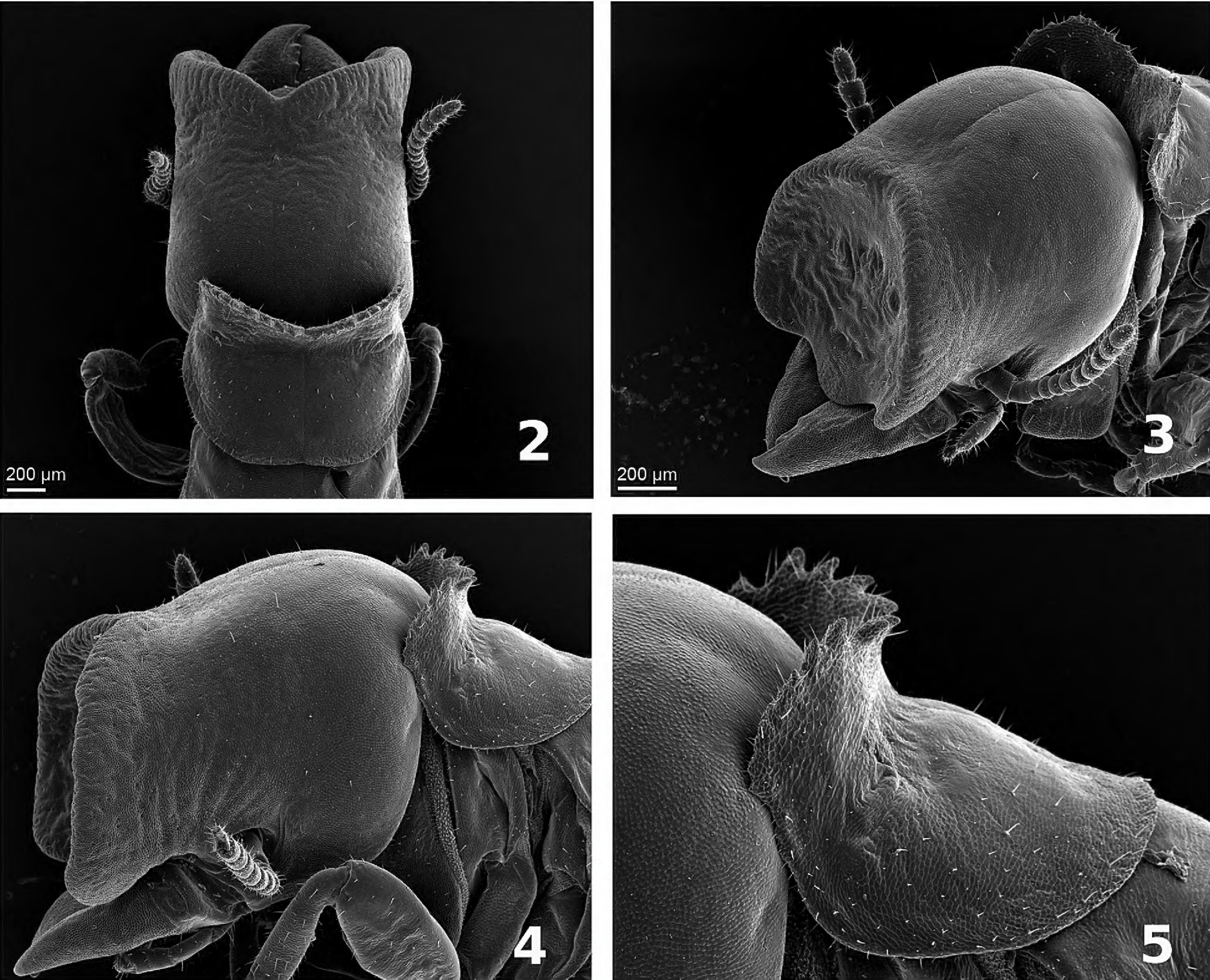
Eucryptotermes breviceps differs from *E. hagenii* by its smaller soldiers and imagoes and by having only 2 tibial spurs on the fore-tibiae. Soldiers of *E. breviceps* also have a shorter and strongly phragmotic head, with a much larger frontal extension covering most of the mandibles in dorsal view (Constantino 1997).

Other kalotermitid genera detected in Argentina, with soldiers showing varying degrees of cephalic phragmosis are *Cryptotermes*, *Glyptotermes* Froggatt, 1897, and *Tauritermes* Krishna, 1961, but the development of their frontal ridge is smaller than in *Eucryptotermes* (Silvestri 1903, Torales et al. 1997, Roisin 2003). In addition, unlike them, the antennae of *Eucryptotermes* are inserted at about one-third or one-half of the head length from the front sides.

Discussion

In our surveys of termites in native forests of the Humedales Chaco Ramsar Site, *E. hagenii* was collected and identified from the Chaco Dominion, Chaco Province, Chaco Humid District for the first time (Fig. 1). In this biome, *E. hagenii* is a sporadic species, because 6 colonies were detected in the 2 transects (12.5% of the analyzed sections). With regard to dominance, it was an accessory species (15.79%), so that the abundance of *E. hagenii* in the analyzed forests was categorized as intermediate. Other 2 colonies of the species were detected in the Reserve during complementary samplings.

We found only 2 nests in Colonia Benítez that had 1 or 2 dealate reproductives. Presumably these are members of the royal couple and suggest that the colonies were monogynous. In November, 7 mature alates were found in a single nest. The mature alates found in November indicate that swarming might take place in late spring or early summer. All colonies were also composed of sol-



Figures 2–5. *E. hagenii* soldiers. **2.** Head and pronotum in dorsal view. **3.** Oblique view of head. **4:** head and pronotum in lateral view. **5.** Lateral view of pronotum. Scale bars: Figs 2–4 = 200 μm, Fig. 5 = 100 μm.

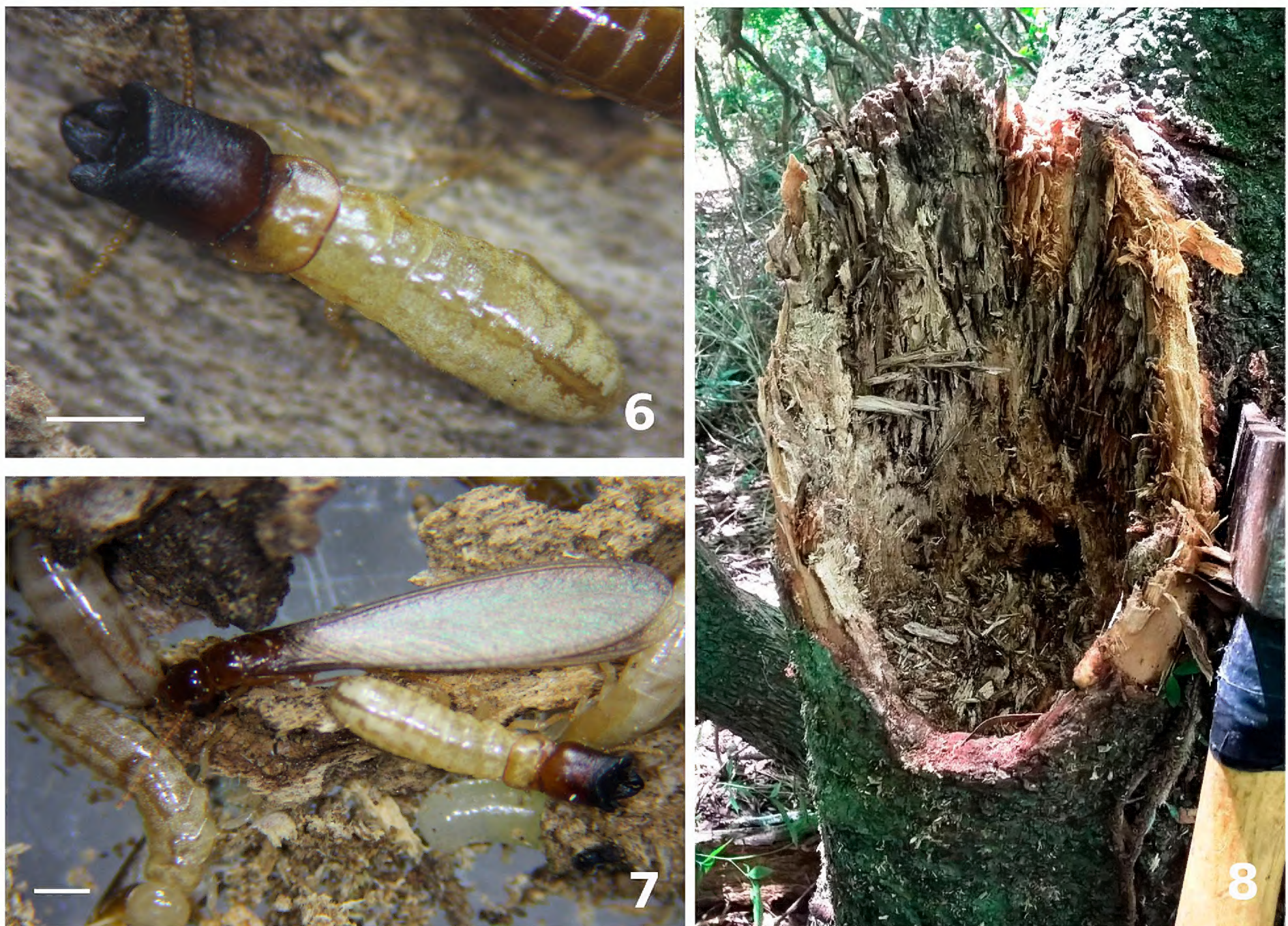
diers, pseudergates, and immature individuals (larvae and white soldiers) (Fig. 7).

For *E. hagenii*, there are few data available on the

microhabitats occupied by *E. hagenii* in natural habitats, such as inside a dead hardwood trunk in a Rio de Janeiro forest (Araujo 1970). This species does not construct

Table 1. Morphometric characters (mm) of *Eucryptotermes hagenii* soldiers and imagoes from Colonia Benítez (Chaco, Argentina). *New data.

Morphometric character	Soldiers (n = 10)	Imagoes (n=10)
	Mean (range)	Mean (range)
Length of head to lateral base of mandibles	0.99 (0.83–1.05)	1.17 (1.06–1.29)
Length of head including mandibles*	1.87 (1.75–2.10)	
Length of head to tip of labrum*		1.46 (1.38–1.53)
Length of head to postclypeus*		1.11 (0.90–1.47)
Width of head with eyes, maximum	1.24 (1.13–1.33)	1.12 (1.02–1.22)
Height of head excluding postmentum	0.99 (0.88–1.15)	0.73 (0.70–0.75)
Frontal flangewidth*	1.22 (1.15–1.28)	
Diameter of eye, maximum		0.37 (0.34–0.41)
Eye to head base distance, minimum*		0.15 (0.12–0.18)
Diameter of ocellus, maximum	0.15 (0.14–0.15)	0.16 (0.14–0.18)
Length of left mandible, maximum	0.87 (0.80–1.00)	
Width of pronotum, maximum	1.14 (1.00–1.28)	1.03 (0.99–1.06)
Length of pronotum, maximum	0.76 (0.60–0.86)	0.68 (0.56–0.72)
Length of hind tibia	0.74 (0.64–0.84)	1.05 (0.92–1.13)
Total body length without wings*	4.44 (3.35–5.36)	5.15 (4.20–6.36)
Total body length with wings*		9.68 (9.30–10.00)
Length of fore wing without scale, maximum*		7.66 (7.40–7.80)
Width of fore wing, maximum*		2.11 (2.05–2.20)



Figures 6–8. Individuals of *E. hagenii* and nesting site. **6.** Soldier. **7.** Alate, soldier and pseudergates. **8.** Location of *E. hagenii* colony inside a trunk of *N. megapotamica* living tree. Scale bars = 0.5 mm.

conspicuous arboreal nests like some termitids, and thus, its detection is difficult and requires exhaustive searching of standing trees and pieces of dead wood. We found this species in galleries excavated inside the trunks of living trees (Fig. 8) and in standing dead wood, as well as in fallen branches. Native trees having colonies of *E. hagenii* were found to be *Nectandra megapotamica* (Spreng.) Mez and *E. contortisiliquum* (Vell.) Morong. Fallen branches sheltering *E. hagenii* were poorly degraded, and the wood still retained its structure, although some had high moisture content.

Eucryptotermes, like other “drywood termites”, have evolutionary characteristics that are considered basal for termites in regard to their morphology, social organization, and nesting type. Nevertheless, the phragmotic head of soldiers is an advanced or derived condition within the family Kalotermitidae; with the addition of prominent mandibles, it is developed as a defensive adaptation to block galleries in the wood and prevent the entry of predators (Krishna 1961, Scheffrahn et al. 1998).

Nine of the 18 morphometric characters measured in soldiers and alates of *E. hagenii* provide new data for the species; our measurements of the other 6 characters extend previously known ranges (Constantino 1997). Our measured values correspond to observations of Constantino (1997), who pointed out that the size of the soldiers varied considerably. His sample size was small, and

while there was no clear geographical pattern, the largest soldiers seemed to be in the southern part of the then-known range, Paraná and Santa Catarina states, Brazil. We cannot corroborate Constantino’s (1997) observations with our specimens from Chaco; the minimum values of length and height of head, length of pronotum and length of hind tibia are smaller than those reported by him.

The previous distributional records of the 2 species of *Eucryptotermes* correspond to the Brazilian and Chaco Subregions within the Neotropical Region. Thus, *E. breviceps* is known from a single locality of the Boreal Brazil Dominion, Roraima Province, whereas *E. hagenii* has been found in the Parana Dominion, Atlantic Province. Both species are recorded from native tropical and subtropical rainforests.

This genus *Eucryptotermes* and *E. hagenii* had been recorded from only 10 places in Brazil (Müller 1873, Araujo 1977, Constantino 1997, Fontes 1998). Our new records extend the distribution of the genus *Eucryptotermes* by approximately 980 km west to the Chaco Dominion, which is characterized by little precipitation and mesophytic or xerophytic forests (Cabrera and Willink 1973, Morrone 2001). The occurrence of *E. hagenii* in this dominion shows that this species has a broader ecological plasticity than what was previously known. Our records are also the first for both the genus *Eucryptotermes* and *E. hagenii* from Argentina. Both the genus and

species were previously thought endemic to Brazil. The number of termite genera in Argentina is increased to 34 (Silvestri 1903, Torales et al. 1997, 2005, Roisin 2003).

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Authors' Contributions

All authors collected the field data; MCG identified the specimens and wrote the manuscript; JMC, GA, and ERL measured the specimens; CE took the digital and SEM photographs.

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